Santa Clara Valley Water District

Water Supply Conditions 76-77

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SANTA CLARA VALLEY WATER DISTRICT

WATER SUPPLY CONDITIONS

ANNUAL REPORT

by

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Groundwater Maps prepared

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SUMMARY OF 1976-77
WATER SUPPLY CONDITIONS

As the drought continued over California, the volume of available surface water and groundwater in storage decreased in Santa Clara County during the water year July 1, 1976 through June 30, 1977. With very low rainfall, 1976-77 ended resulting in large decreases of groundwater in storage of 94,700 acre-feet in the Santa Clara Valley Groundwater Basin, 4,500 acre-feet in the Coyote Groundwater Basin, and 20,400 acre-feet in the Llagas Groundwater Basin.

During this same period, the District imported 89,700 acre-feet of water through the South Bay Aqueduct. The Rinconada Water Treatment Plant treated 47,400 acre-feet of this water and the Penitencia Water Treatment Plant treated 13,000 acre-feet. The Penitencia Plant supplies treated water to the east side of North Santa Clara Valley.

Significant subsidence has been effectively halted since 1969. This resulted from groundwater levels having risen above and having remained above the critical pressure elevation. However, continuation of the drought would reverse this and might cause a recommencement of subsidence.

Groundwater continues to be high-quality water usable for all beneficial purposes. However, certain localized areas have yielded groundwater of poor mineral quality. Inspection of groundwater chloride-concentration data indicates that the limits of saltwater contamination in most places have not changed significantly during the period 1949 through 1977.

INTRODUCTION

This annual report covers the water year 1976-77 which extends from July 1, 1976 to June 30, 1977. Its purpose is to inform the District Board of Directors and interested citizens of the current condition of the District's water supplies.

In previous years this annual report was intended to display the groundwater conditions in the three major groundwater basins of Santa Clara County. To be more useful, this report has been expanded into a water supply conditions annual report with an equal emphasis upon the other elements of the hydrologic cycle.

The three major groundwater basins, which are interconnected and occupy nearly 30 percent of the total county area, are the Santa Clara Valley, Coyote and Llagas Basins, shown on Plate 1. Groundwater usually supplies about 50 percent of the total water used in the Santa Clara Valley Basin and almost all of that used in the Coyote and Llagas Basins. The remainder is supplied from local surface diversions and imported sources.

Zones of benefit have been established for the conservation, importation, treatment and distribution of water used in Santa Clara County and are shown on Plate 1.

Zone W-2 encompasses the Santa Clara Valley Groundwater Basin and was formed for the registration of those groundwater producing facilities that benefit from recharge of the groundwater basin by the District with local and imported water. In this zone, a charge is levied for groundwater extracted and the revenue thus derived is used to support the District's conservation and

importation program. Major sources of water supply income are the groundwater charge levied in Zone W-2 and the sale of treated water. The groundwater charge for nonagricultural uses during 1976-77 was $34 an acre-foot, and for agricultural uses the groundwater charge was $8.50 an acre-foot. Treated water was sold at $75 an acre-foot, with water in excess of contracted amounts sold at $45 an acre-foot.

Zone W-4 encompasses all of Zone W-2 plus the lands of water consumers outside of Zone W-2 that use or otherwise benefit from locally conserved water and from the importation and distribution of water from the South Bay Aqueduct. In this zone, a property tax rate of $.018 per $100 of assessed valuation was levied to pay for the cost of water purchased to recover the accumulated overdraft in the groundwater basin, control land surface subsidence, and sustain an emergency supply of water.

In Zone W-3, comprising most of the Coyote Basin, an ad valorem tax of $.438 per $100 of assessed value (on land only) was levied in lieu of a groundwater charge. The subzones within Zone W-3 were formed for the purpose of assessing a groundwater charge on pumping facilities that export water from the Coyote Groundwater Basin to areas outside of Zone W-3. No groundwater charge was levied in the Llagas Basin.

Another tax levied in the County is the Countywide Tax, intended to pay the capital cost of water importation facilities and that portion of the costs of reservoirs allocated to recreation.

HYDROLOGIC BALANCE

For the second consecutive year, rainfall in Santa Clara Valley was seriously below average. The San Jose station, which averages 14.02 inches based on 103 years of record, recorded 8.98 inches while 12.45 inches were recorded at Gilroy which averages 21.1 inches.

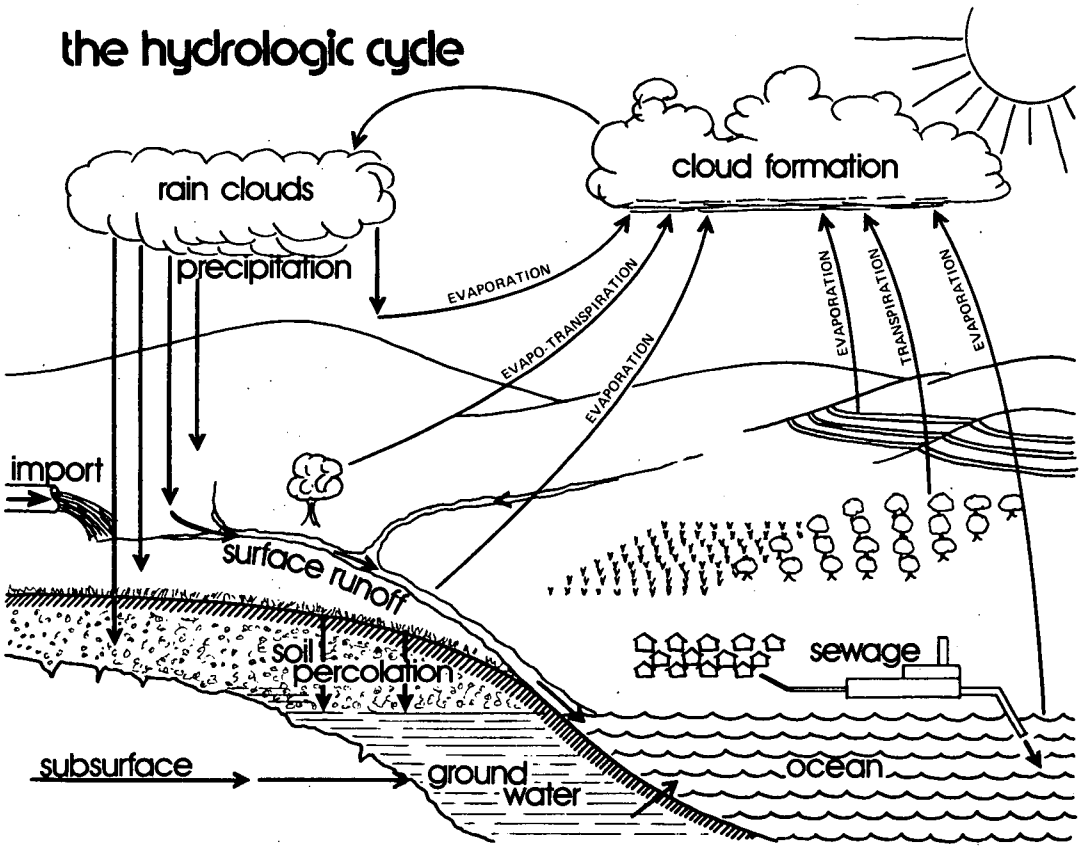
All of the reservoirs continuously declined to the low levels indicated in Table 1. Inspection of Table 1 reveals that as of June 30, 1977 the larger reservoirs were significantly lower than at the end of the preceding year.

Each of the three groundwater basins experienced decreases in the volume of water in storage. As water levels rise and fall, the volume in storage changes. This change of stored water in the unconfined zone can be approximated by multiplying estimates of the storage capacity for the aquifer materials by the area and by the change in depth between groundwater levels at the beginning and end of the season (Plate 3). This year decreases of 94,700 acre-feet in the Santa Clara Valley Basin, 4,500 acre-feet in the Coyote Basin and 20,400 acre-feet in the Llagas Basin were computed.

These estimates were checked by balancing the hydrologic components of water supply and utilization. Water supply consists of precipitation, stream inflow, imported water and subsurface inflow. Water is utilized or lost by consumptive use, sewage export, stream outflow and subsurface outflow. The difference between supply and utilization is the net surplus or deficit of

water in storage in the groundwater reservoirs at the end of the season. The hydrologic balance, illustrated in Figure 1, shows that the decrease in the Santa Clara Valley Basin was 95,000 acre-feet, the decrease in the Coyote Basin was 4,400 acre-feet, the decrease in the Llagas Basin was 20,200 acre-feet (these compare favorably to the previously obtained deficiencies of 94,700, 4,500 and 20,400 acre-feet, respectively).

The discrepancy observed between the storage changes obtained as a net balance of hydrologic components and that obtained as a product of change in water levels and storage capacity is the result of uncertainties involved in the estimation of subsurface inflows, consumptive use and the storage coefficient of aquifers. However, the results are well within the accuracy acceptable for this kind of computation.



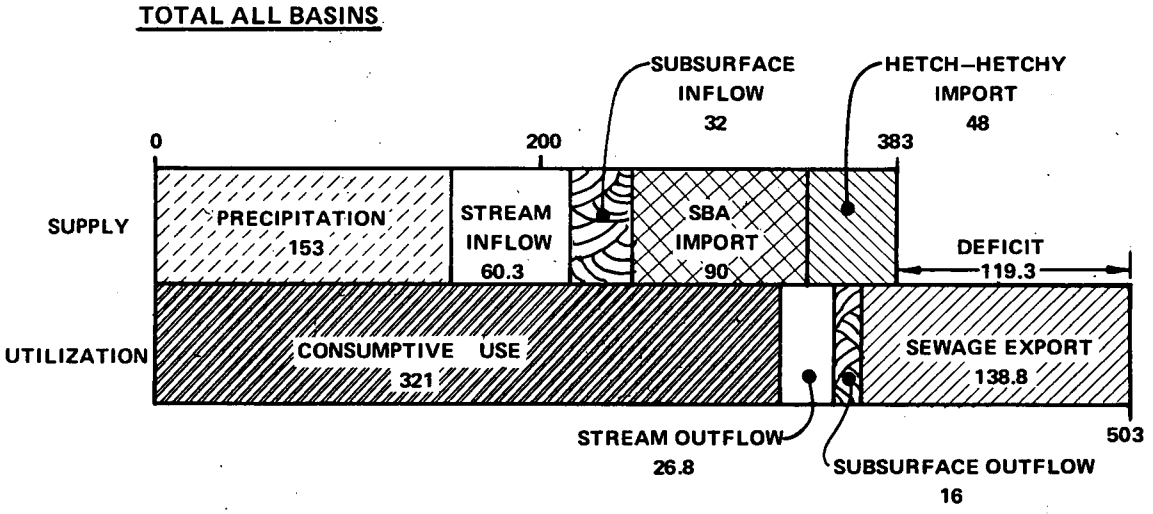
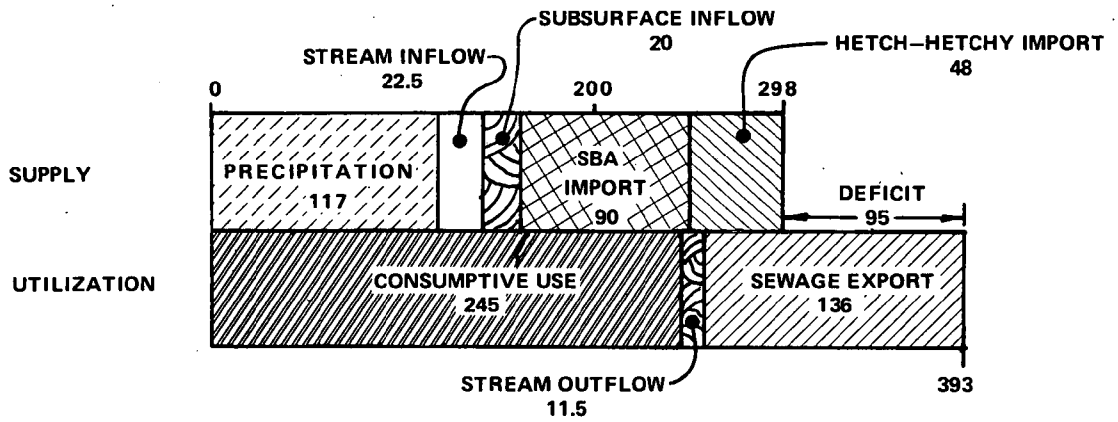
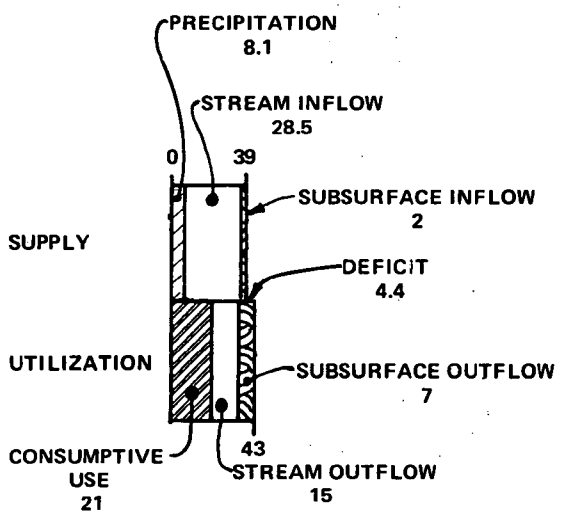


FIGURE 1 - HYDROLOGIC BALANCE OF GROUNDWATER 1976-77
(VALUES IN 1000's ACRE FEET)

SANTA CLARA VALLEY G.W. BASIN
1000's OF ACRE FEET



COYOTE G.W. BASIN



LLAGAS G.W. BASIN

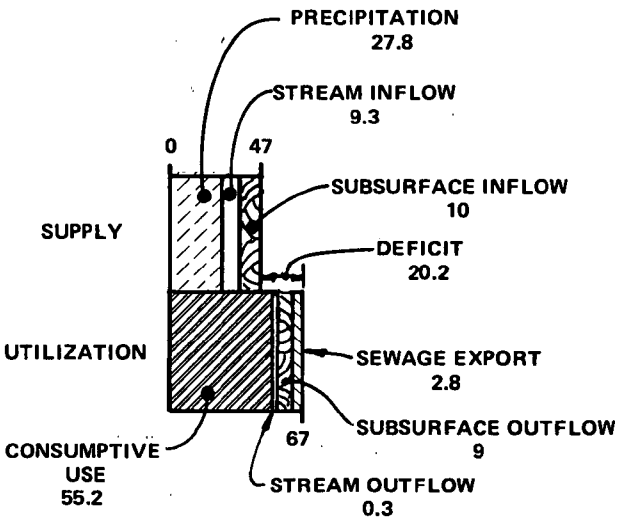


TABLE 1 - RESERVOIR STORAGE ON JULY 1 '76 AND JULY 1 '77

Reservoir	Capacity	Storage in Ac-Ft on July 1 '76	Percent Full	Storage in Ac-Ft on July 1 '77	Percent Full
Almaden	1,780	50	2.8	0	0
Anderson	91,280	49,200	53.9	20,295	22.2
Calero	10,160	3,450	40.0	652	6.4
Chesbro	8,086	1,450	17.9	0	0
Coyote	23,700	10,300	43.5	0	0
Guadalupe	3,740	100	2.7	216	5.8
Lexington	20,210	1,000	5.0	344	1.7
Pacheco	6,135	250	4.1	80	1.3
Stevens Creek	3,600	140	3.9	0	0
Uvas	10,000	500	5.0	10	0.1
Vasona	410	396	96.6	231	56.3
		66,836		21,828	

GROUNDWATER LEVELS

A groundwater contour map, showing lines of equal elevation of water levels in wells as of September 1, 1977 (traditionally the seasonal low), is shown on Plate 2. Plate 3 shows lines of equal change in elevation of water in wells between September 1, 1976 and September 1, 1977. Plate 4 shows lines of equal depth to water as of September 1, 1977. These groundwater contours are based on information from more than 400 wells.

The change in groundwater storage is obtained by use of the Equal Change in Groundwater Contour Map representing as close as possible the two low points. Since 1976-77 was a drought year the low points occurred later than a normal year; therefore, the period from September 1, 1976 to September 1, 1977 was used for the change map and in computing the mass balance of each basin.

Groundwater levels* for the Santa Clara Valley Basin show a decline of 18 feet from 1976 levels while the Coyote and Llagas Basins show drops of 8 and 12 feet, respectively.

The District is continuing its program of recharge of the Santa Clara Valley Groundwater Basin with local and imported water. On the average, more than 100,000 acre-feet per year are recharged. However, in 1976-77, only 65,000 acre-feet were recharged in the Santa Clara Valley Groundwater Basin. Since there was little runoff from rainfall, this was only possible by using water which was left over from previous years in the District's reservoirs and importing water through the South Bay Aqueduct.

*Determined from the unconfined area of the groundwater contour map.

About 18,000 acre-feet of water were recharged from existing reservoir supplies and about 28,600 acre-feet were recharged from imported South Bay Aqueduct water. Additionally, 6,900 acre-feet of water were recharged in South County from Anderson Reservoir through the Main Avenue and Madrone Channel recharge facilities.

An index of the monthly fluctuation of water levels from 1973 to 1977 in the Santa Clara Valley, Coyote, and Llagas Basins is presented in Figure 2. These numerical quantities are only an index since they represent the weighted average of depths to water in 35 representative wells in both the confined and unconfined zones which are monitored at the beginning of each month. The index does not represent the actual depth to water at any point within the basin. The intent is to show the trend over the last five years in the change of groundwater levels for that basin.

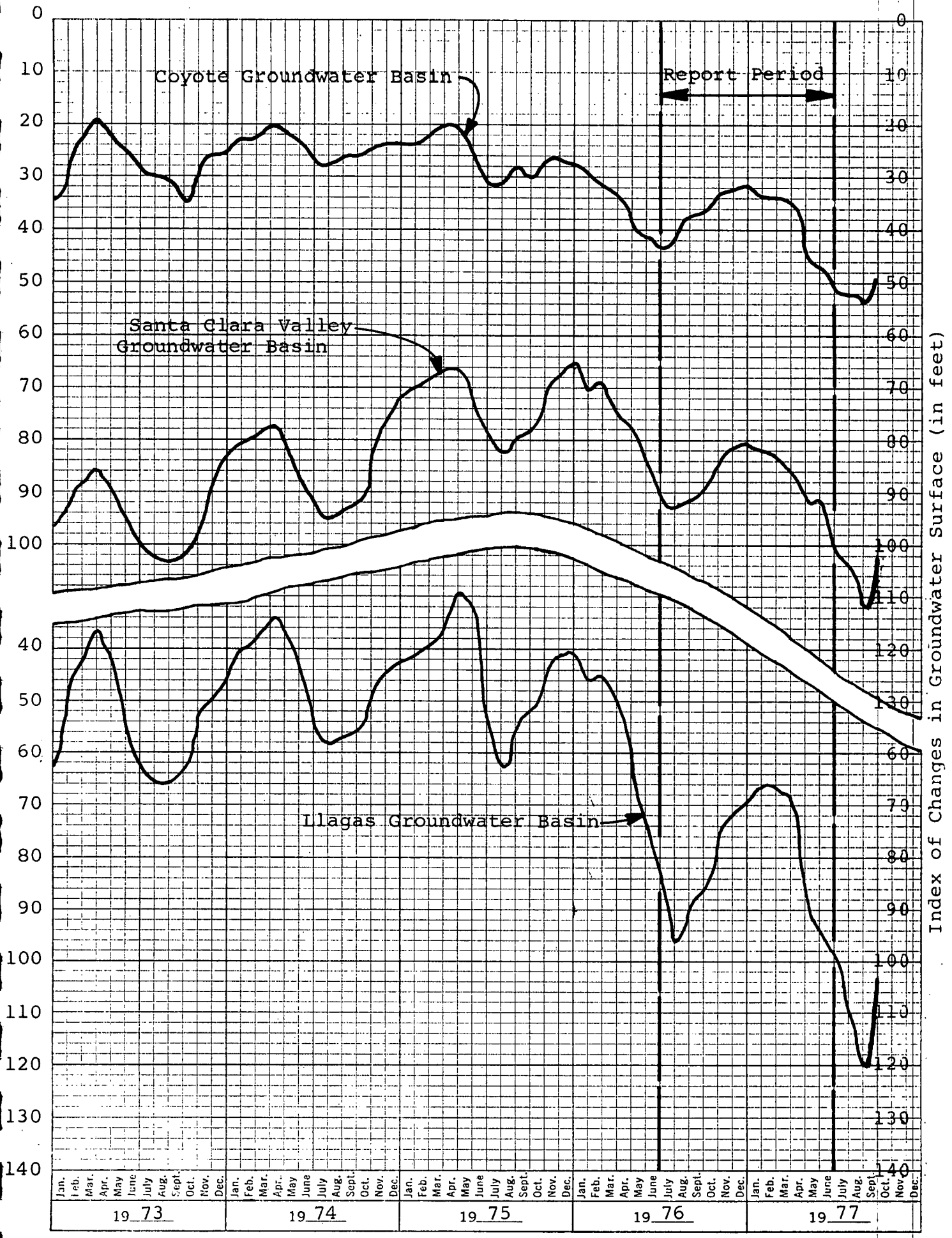


Figure 2 - Index of Groundwater Levels

LAND SURFACE SUBSIDENCE

Subsidence of the land surface occurs when intensive groundwater pumping results in lowered water pressures in the groundwater basin materials. This increases the effective overburden load on the clay materials in and separating aquifers causing the clay materials to compact, with consequential sinking of the overlying land surface. From 1912 to 1969 (the year when significant subsidence stopped), the cumulative land subsidence, as measured by the National Oceanic and Atmospheric Administration (formerly U. S. Coastal Geodetic Survey) at the bench mark in San Jose, was 12.89 feet. Since 1967 a precise level circuit has not been rerun to all bench marks throughout the areas of subsidence. However, the District established a single level circuit around the south end of San Francisco Bay that was run annually from 1963. This line of levels was not run since 1976 because the amount of land surface subsidence was less than the accuracy of the leveling. Furthermore, the U.S. Geological Survey maintains two extensiometer wells that do measure changes in elevation at these wells. These wells indicate a change (lowering) in land surface elevation of a few millimeters during the period from October 1976 to October 1977. This is not considered a significant amount. However, if drought conditions and overdraft of the groundwater basin continue, land surface subsidence can be expected to recur if water levels drop below a critical level.

Land surface subsidence has cost Santa Clara County residents millions of dollars because of its direct effect on the design

of and damage to flood control channels, bayfront levees, wells, sanitary sewer lines and other underground utilities.

The District has been working toward the goal of obtaining water supplies adequate to prevent the overdraft of groundwater and to raise water levels. As a result, over the years, of increased imported water supplies, average rainfall (until recently), artificial recharge, and decreased pumping, groundwater levels have steadily recovered since 1967. Continued halting of land surface subsidence is dependent on maintaining groundwater levels above those prevailing in 1969.

GROUNDWATER QUALITY

Groundwater pumped from most of the existing wells in the County's basins is of good quality and, in general, meets or exceeds all requirements for drinking water as set forth in the Standards of the U. S. Public Health Services. Groundwaters from properly constructed and protected wells, including many municipal well fields, are in some places used directly without chlorination.

Graphical representations of some significant water quality parameters at selected wells are shown in Figure 3. The locations of these wells are shown on Plate 1. Generally, the pumped water may be classified as moderately to extremely hard. Hardness of water is caused principally by some compounds of calcium and magnesium.

Certain localized areas have yielded groundwater of poor quality. Groundwater is subject to contamination in areas of intensive land use. The principal surface sources of contamination are septic tanks, surface ponding of contaminants and pollutants, fertilizers, and questionable waste disposal practices. From subsurface sources, the threat of degradation comes from saltwater intrusion from San Francisco Bay (Plate 5) or from mineralized connate waters found at depth.

Another factor which may contribute to the degradation of the groundwater is the method of well construction. Properly constructed wells eliminate the possibility of the well functioning as a conduit for the movement of water between contaminated (or degraded) and uncontaminated aquifers and

GROUNDWATER QUALITY VARIATIONS
SANTA CLARA VALLEY AND LLAGAS GROUNDWATER BASINS

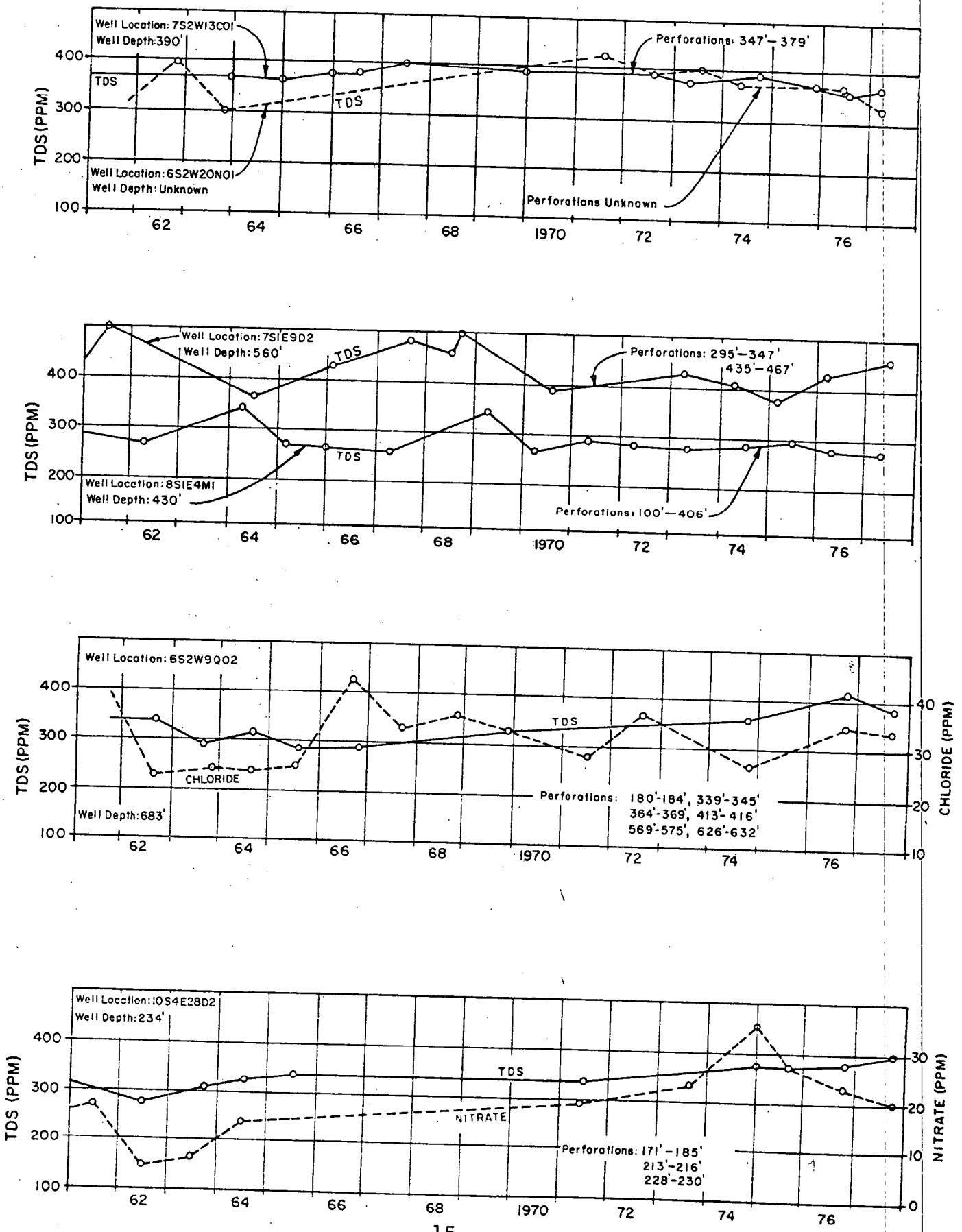


Figure 3

also prevent contamination from surface sources. Improper methods of well construction and destruction, if allowed, could contribute to the deterioration of freshwater aquifers. Once an aquifer becomes contaminated or degraded, its restoration is extremely difficult and expensive. In order to help prevent degradation of the groundwater in Santa Clara County, the District has adopted well construction and destruction standards (SCVWD Ordinance No. 75-6). The purpose of these standards is to protect and preserve the groundwater supply for future uses.

To aid in the management and protection of the quality of all the waters in the valley, the District has continued a joint water quality program with the California Department of Water Resources and the U. S. Geological Survey. The objective of the program is to develop a comprehensive plan for monitoring the quality of waters in the underground basins, streams, and the surface reservoirs.

SALTWATER CONTAMINATION

Along the margins of South San Francisco Bay are shallow aquifers (less than 150 feet deep), which contain saltwater contaminated water. These aquifers and the poor quality water they contain are important to water management within the County because they overlie the deep and, for the most part, undegraded artesian aquifers which are a major source of water supply to the County. Therefore, the delineation of areas where the shallow groundwater is of inferior quality is an aid in assessing potential hazards to the deep aquifers and in planning for their protection against contamination.

The chloride content of local uncontaminated, shallow groundwater normally is less than 50 mg/l. When levels of mineralization are found to be substantially greater, it can be reasonably assumed that some special contaminating influence is involved. A chloride index level of 100 mg/l was adopted to define areas which have been subjected to noticeable alteration of quality. Plate 5 delineates the gross areas within which maximum shallow zone chloride concentrations of 100, 500, 1,000 and 2,000 mg/l have been found.

The distribution pattern of excessive chloride occurrence shows a bay-related origin for shallow zone contamination. Several possible contamination processes are suggested by these patterns. Although the available data does not allow a conclusive analysis, there is a reasonable basis for preliminary and tentative concepts pending further investigation.

The incursion of tidal waters inland along watercourses appears to affect near surface semi-perched aquifers in adjacent areas. Inland incursion of tidal waters has increased markedly along most watercourses. Land surface subsidence has been chiefly responsible for this by lowering channel elevations.

The stream most affected by channel lowering and increased tidal incursion is Guadalupe River, due to its location in areas of greatest subsidence and to channel improvements which have lowered the channel bottom. This has allowed tidal effects to reach several miles farther inland along Guadalupe River. This appears to be reflected by the southerly prolongation of shallow groundwater contamination delineated in Plate 5.

In the vicinity of the Palo Alto Baylands, it is suspected that saltwater contamination has resulted from the classical intrusion from the bay waters. To reduce this intrusion and protect the aquifer, the District has designed a system which will inject water into the shallow aquifers through wells. The injected water will set up a hydraulic barrier against intrusion.

The water for injection will be furnished by a four million gallons per day Water Reclamation Plant which provides advanced treatment of effluent from the Palo Alto Regional Water Quality Control Plant.

A key part of the implementation of the reclaimed water well injection program is the comprehensive monitoring program with special emphasis upon public health aspects. The aquifer into which reclaimed water will be injected is not currently used for a public water supply. Thus, the project has the unique possibilities of helping to prevent contamination of good quality

groundwater at depth while at the same time providing the basis for research into the possible utilization of reclaimed water to help meet future water needs.

SURFACE WATER SUPPLY

Precipitation

Rainfall is the source of all locally developed water supplies. The long-term precipitation at San Jose is illustrated in Figure 4 as the accumulated departure from the mean which denotes graphically the wet and dry periods of rainfall. The important feature in Figure 4 is the slope of the line; particularly whether it is positive (up) or negative (down). Each point is plotted as a difference from the long-term averages; a wet year showing a positive difference and a dry or below normal rainfall year indicating a negative difference. If each difference is added to that of the previous year, a trend of positive or negative increments becomes apparent. An upward trend would, therefore, indicate a period of years which have received above normal rainfall and a downward trend would be indicative of a below normal period.

The accumulated departure from the mean is used to identify long-term wet and dry periods. Despite short-term fluctuations, the long-term periods are evident in Figure 4.

Beginning in 1875, rainfall approximated the long-term average until 1890 when a series of wet years began which generally continued until about 1916. The valley experienced low rainfall for several years following 1920 until 1935. It was during this drought period that valley residents first initiated a comprehensive water conservation program. The completion of the valley's first five water supply reservoirs in 1935 coincided with a short interval of above-average rainfall. This enhanced

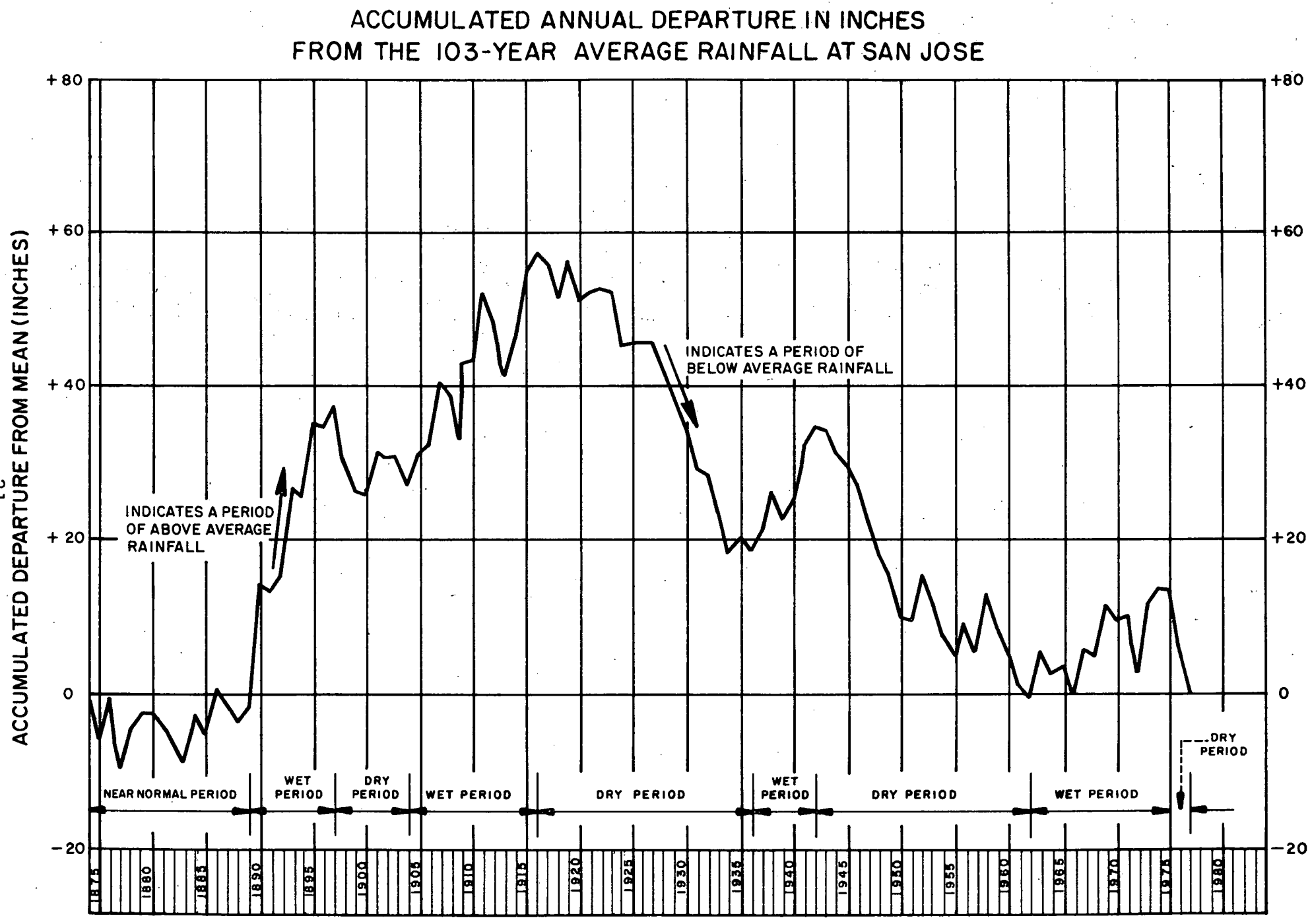

ACCUMULATED ANNUAL DEPARTURE IN INCHES
FROM THE 103-YEAR AVERAGE RAINFALL AT SAN JOSE
ACCUMULATED DEPARTURE FROM MEAN (INCHES)
+80
+60
+40
+20
0
-20
INDICATES A PERIOD OF ABOVE AVERAGE RAINFALL
INDICATES A PERIOD OF BELOW AVERAGE RAINFALL
NEAR NORMAL PERIOD
WET PERIOD
DRY PERIOD
WET PERIOD
DRY PERIOD
WET PERIOD
DRY PERIOD
WET PERIOD
DRY PERIOD
1875
1880
1885
1890
1895
1900
1905
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980

Figure 4

the water supply picture and enabled groundwater levels, which had been declining, to recover.

Between 1943 and 1962, another series of dry years occurred. From 1962 to 1975, the valley has had rainfall slightly above the long-term average. However, since 1975, rainfall has totaled far below average.

The demand for water and the amount of water available for supply are both very dependent on seasonal rainfall. In a below normal rainfall year when water supplies are low, the demand for municipal, industrial and agricultural water increases, while in a wet year, water demand drops. Shown on Figure 5 is the recorded water use for the period 1970 through 1977. Estimates of the seasonal groundwater extractions through 1978 for each of the three basins are shown in Table 2. Actual water production in the North Santa Clara Valley Groundwater Basin for 1970-77 from all sources of supply is summarized in Table 3 and for 1976-77 is illustrated on Figure 6.

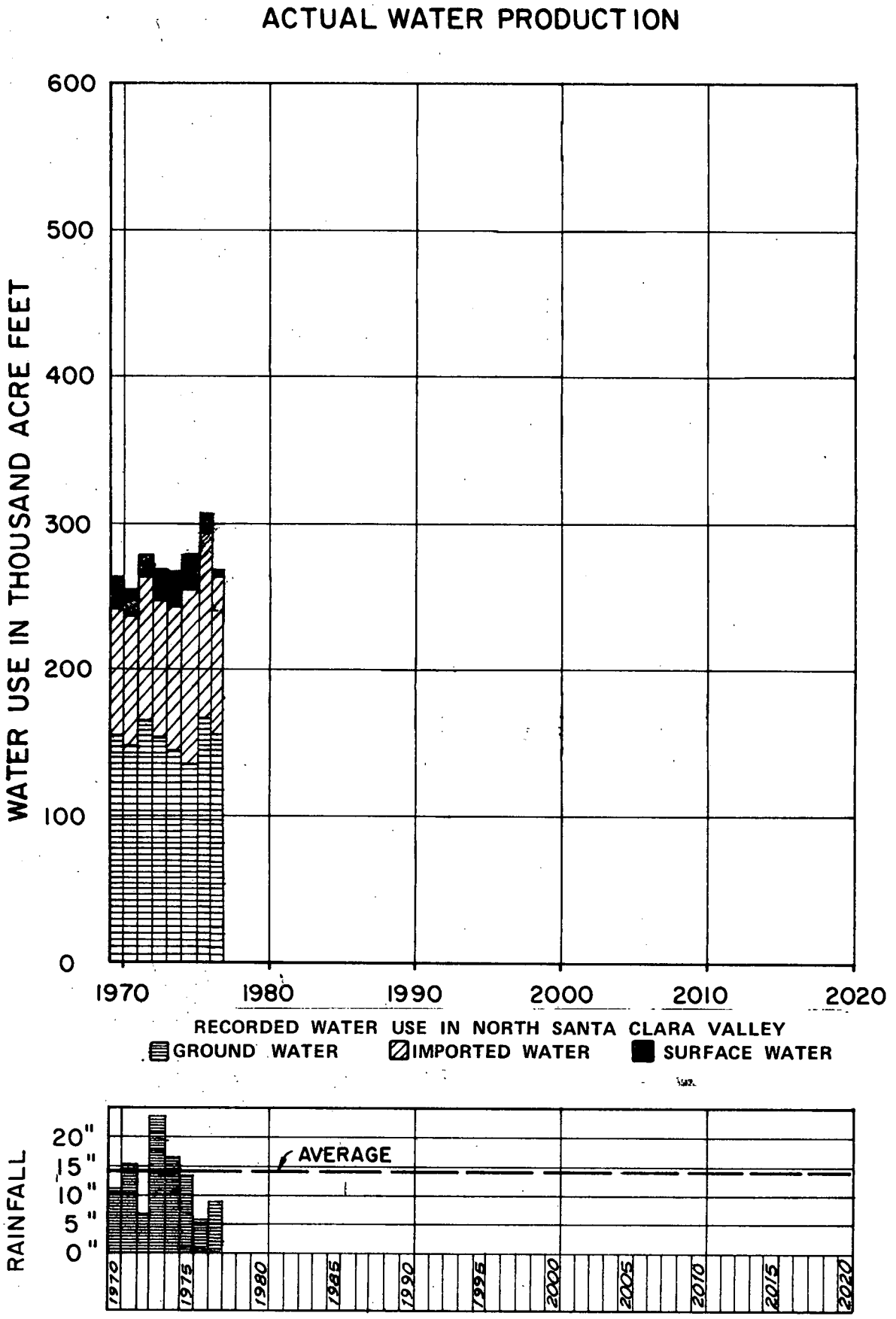
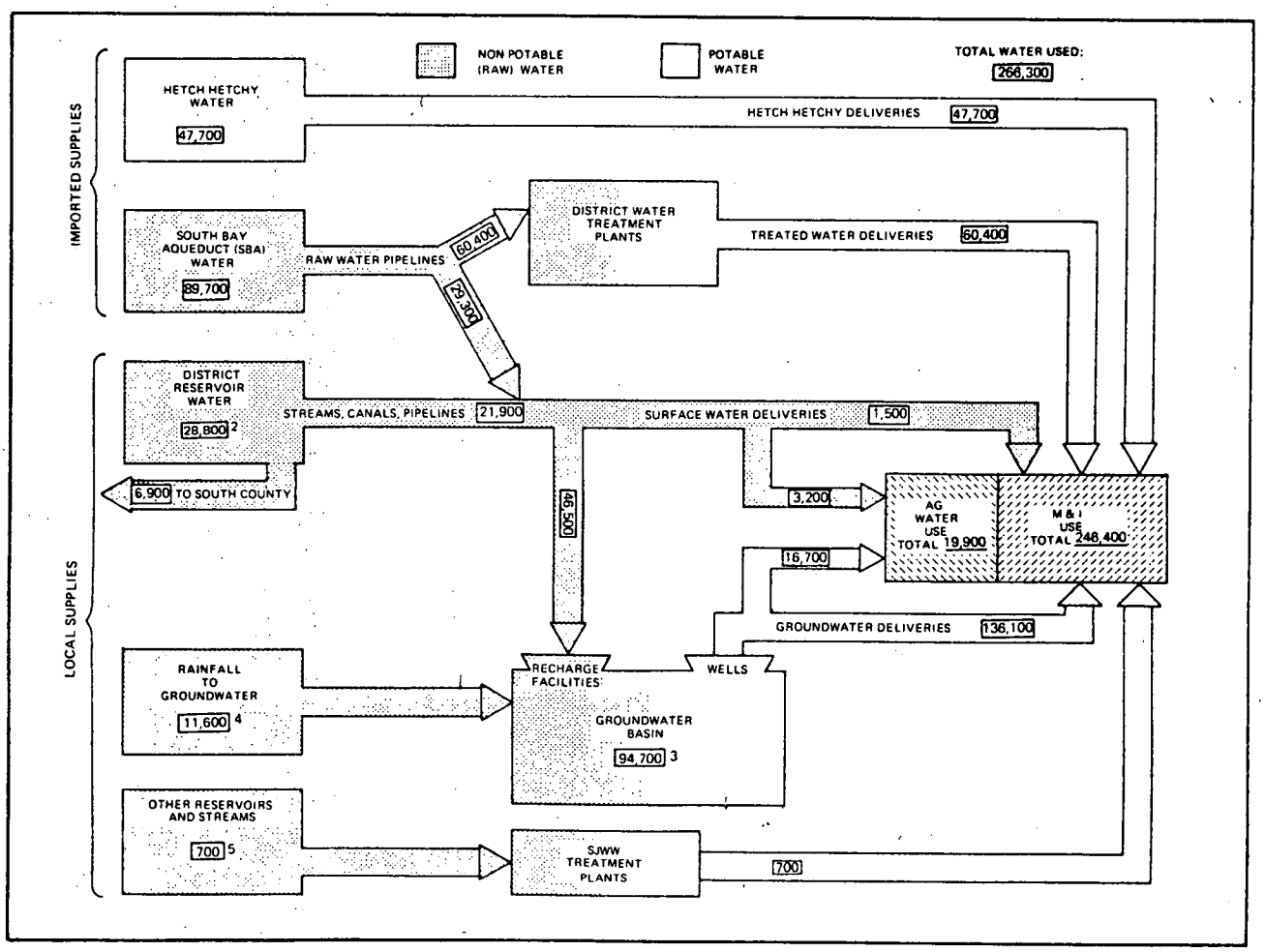

ACTUAL WATER PRODUCTION
WATER USE IN THOUSAND ACRE FEET
600
500
400
300
200
100
0
1970
1980
1990
2000
2010
2020
RECORDED WATER USE IN NORTH SANTA CLARA VALLEY
GROUND WATER
IMPORTED WATER
SURFACE WATER
RAINFALL
20"
15"
10"
5"
0"
AVERAGE
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

FIGURE 5

WATER SUPPLY AND USE
NORTH SANTA CLARA COUNTY
1976-77

(ALL VALUES IN ACRE-FEET)[1]



1. Water quantities rounded to the nearest 100 acre-feet.
2. Includes 3,100 acre-feet of reservoir inflow and 25,700 acre-feet withdrawn from water in storage from previous years.
3. 94,700 acre-feet were overdrafted from the Santa Clara Valley groundwater basin resulting in a significant drop in the average depth to groundwater.
4. Includes unmeasurable subsurface inflow.
5. From previous year's storage.

FIGURE 6

TABLE 2

ESTIMATED SEASONAL GROUNDWATER EXTRACTIONS
(VALUES IN ACRE-FEET)
ASSUMING AVERAGE RAINFALL

Water Year and Use	Groundwater Basin: Santa Clara Valley	Coyote	Llagas	Total
1976-77				
Agric. Use	16,700*	11,500	65,700	93,900
Urban Use	136,100*	500	10,700	147,300
Total	152,800*	12,000	76,400	241,200
1977-78				
Agric. Use	17,400	12,000	67,500	96,900
Urban Use	126,000	500	11,000	137,500
Total	143,400	12,500	78,500	234,000
1978-79				
Agric. Use	17,400	12,000	69,500	98,900
Urban Use	128,000	500	11,300	139,800
Total	145,400	12,500	80,800	238,700

*These are the recorded extractions.

TABLE 3

WATER USE SUMMARY

Santa Clara Valley Groundwater Basin

(values in acre-feet)*

Fiscal Year	Surface Water Ag	Surface Water Non-Ag	Groundwater Ag	Groundwater Non-Ag	Distribution of SBA Import** Treated	Distribution of SBA Import** Untreated	Hetch Hetchy	SJWW Diversion	Total
69-70	4,900	800	29,300	125,100	39,200	500	48,300	15,800	263,900
70-71	4,400	1,100	23,700	124,300	44,000	700	45,200	12,900	256,300
71-72	4,800	1,500	24,000	142,200	48,800	800	49,900	8,800	280,700
72-73	4,200	1,600	17,500	137,800	45,000	600	48,900	14,600	270,200
73-74	3,000	1,800	15,900	129,000	45,500	600	52,200	20,800	268,700
74-75	3,500	1,900	16,900	120,400	67,400	600	53,400	17,500	281,600
75-76	5,000	2,000	20,000	148,500	66,100	800	56,800	8,500	307,700
76-77	2,500	1,500	16,700	136,100	60,400	700	47,700	700	266,300

* Numbers rounded to nearest 100 acre-feet.

** Imported SBA Water recharged to the groundwater basin included in groundwater used.

Weather Modification

In its search for additional means of increasing its water supply, the District has been conducting cloud seeding operations since December of 1951.

Under natural conditions only a small amount of the moisture that passes over the valley in the form of clouds ever reaches the ground as rain or snow. The function of a cloud seeding program is to increase total precipitation by introducing artificial nuclei into the clouds at the proper time and location.

The basic conditions for successful operation of the District's weather modification program occur when warm, moisture-laden air masses from the Pacific Ocean are driven over the Santa Cruz Mountains by the westerly and southwesterly winds that prevail during storms. As these air masses approach the mountains, they are forced to rise abruptly producing turbulence and rapid vertical velocities. When cloud droplets rapidly rise to higher altitudes above the freezing level, they form into ice crystals around minute particles of natural nuclei, such as salt, dust, hydrocarbon particles, and other substances. When these ice crystals fall to an elevation where the temperature is above the freezing point, they melt, thereby forming raindrops which continue to grow as they fall to earth.

Minute crystals of silver iodide also act as nucleating agents and become effective at higher temperatures than natural nuclei. One gram of silver iodide produces millions of nuclei.

Ground-based generators located near the crest of the Santa Cruz Mountains are used to produce the nuclei which are carried

aloft by the rising air currents passing over the mountains.

Not all storms are suitable for seeding. Much information about the storm is needed before a decision to seed can be made. The operation is controlled from the District's Weather Center building located on a low hill near the center of the Santa Clara Valley at an elevation of approximately 450 feet above sea level. The Weather Center houses weather radar, radio, and equipment for receiving meteorological data.

Depending on conditions, the generator operators are called from the Weather Center and instructed to turn the generators on or off. Generator operators live in the area where a generator is located.

In years of low total rainfall, such as 1976-77, cloud seeding apparently has little beneficial effect. This is to be expected considering the basic theory of cloud seeding; cloud seeding is a rain-increasing and not a rain-making process. During dry years few, if any, opportunities exist for seeding.

An increase in seasonal rainfall has been indicated to range between 10% and 15% for those years when cloud seeding was conducted.

Prior to any seeding, a determination is made relative to reservoir storage, runoff, and anticipated rainfall intensity, and, if any chance of flooding is possible, seeding is not conducted.

In 1975-76 no seeding was performed since it was determined that the District must prepare and file an environmental impact report. Upon its completion, seeding was resumed.

Imported Water

The primary source of imported water for Santa Clara County is the South Bay Aqueduct. During the 1976-77 water year, 89,700 acre-feet of water was delivered into Santa Clara County through the South Bay Aqueduct. Of this total, 47,400 acre-feet was treated at the Rinconada Water Treatment Plant and 13,000 acre-feet was treated at the Penitencia Water Treatment Plant for delivery to consumers through retail water agencies. In addition, 700 acre-feet of raw water was delivered directly from District pipelines for use by individual contractors. The remaining 28,600 acre-feet was recharged into the underground water supply through the District's recharge facilities.

For the calendar year 1977, the District was obligated by contract to purchase its entitlement of 88,000 acre-feet from the State. However, the District was notified that because of the drought the available supply would not allow the State to deliver the full contract amount. Instead only 73,000 acre-feet would be available.

San Francisco Water Department's Hetch Hetchy Aqueduct provides a second source of imported water. During the water year 1976-77, this system delivered 47,700 acre-feet directly to the water supply systems of the cities of Milpitas, San Jose, Sunnyvale, Santa Clara, Mountain View and Palo Alto and to the Purissima Hills County Water District. Small amounts of this water were also delivered to Stanford University, NASA, Moffett Field, Agnews State Hospital and other local contractors.

The existing and proposed water conveyance, treatment and

distribution system for the Santa Clara Valley is shown in Figure 7.

SCVWD RECLAMATION FACILITY (PALO ALTO)
MILPITAS RECLAMATION PROJECT
HETCH HETCHY CONNECTION
HETCH-HETCHY AQUEDUCT
SOUTH BAY AQUEDUCT
MILPITAS RESERVOIR AND DISTRIBUTARY
NO. SAN JOSE DISTRIBUTARY
MILPITAS PIPELINE
PENITENCIA TREATMENT PLANT EXPANSION
MT. VIEW DISTRIBUTARY
WEST PIPELINE EXTENSION
SUNNYVALE DISTRIBUTARY
EAST PIPELINE
EAST RESERVOIR AND DISTRIBUTARY
WEST RESERVOIR AND DISTRIBUTARY
PARALLEL WEST PIPELINE
STEVENS CREEK RESERVOIR
STEVENS CREEK P.L.
SANTA CLARA DISTRIBUTARY
CAMPBELL DISTRIBUTARY
CENTRAL PIPELINE
WEST PIPELINE
EVERGREEN PUMP STATION
EVERGREEN CANAL
SOUTH SAN JOSE DISTRIBUTARY
COYOTE CANAL
ALMADEN PIPELINE I
RINCONADA TREATMENT PLANT EXPANSION
VASONA PUMP STATION EXPANSION
VASONA RESERVOIR
COYOTE ALAMITOS CANAL
COYOTE W.T.P.
COYOTE FORCE MAIN
COYOTE FORBAY AND PUMP STATION (USBR)
ALMADEN PIPELINE II
SANTA TERESA PIPELINE
GUADALUPE RESERVOIR
LEXINGTON RESERVOIR
ALMADEN CALERO CANAL
ANDERSON RESERVOIR
ALMADEN RESERVOIR
CALERO OUTLET ENLARGEMENT
CROSS VALLEY PIPELINE
MAPLE AVE. RECHARGE FACILITY AND PIPELINE
HALF ROAD PIPELINE
CALERO DAM AND RESERVOIR ENLARGEMENT
MADRONE
SAN MARTIN PIPELINE
CHESBRO RESERVOIR
MORGAN HILL PIPELINE
COYOTE RESERVOIR
CHANNEL
GILROY PIPELINE
SAN MARTIN W.T.P.
UVAS RESERVOIR
SANTA CLARA CONDUIT (USBR)
MADRONE-LLAGAS PIPELINE
UVAS RECHARGE FACILITY
WATER RECLAMATION FACILITY-GILROY
HOLLISTER CONDUIT (USBR)
SANTA CLARA TUNNEL (USBR)
SAN LUIS RESERVOIR
PACHECO PUMPING PLANT
PACHECO RESERVOIR
PACHECHO TUNNEL (USBR)
PACHECO CONDUIT (USBR)
N
LEGEND
EXISTING FACILITIES
PROPOSED FACILITIES (STAGES I, II, III)
RECHARGE FACILITY
WATER TREATMENT PLANT
PUMP STATION
RESERVOIR
PIPELINE
Santa Clara Valley Water District
WATER CONVEYANCE, TREATMENT AND DISTRIBUTION SYSTEM
FEBRUARY 1978

Figure 7

WATER CONSERVATION

As the period of low rainfall continued for the second consecutive year, not only for Santa Clara Valley, but the entire State of California, the Santa Clara Valley Water District stepped up its Water Savings Program. Media used to promote water savings included: Speakers Bureau, County Fair, literature, radio and television public service announcements, mobile display, newspaper publicity, tours, and "reminder" items such as buttons, bumper stickers and posters. The District purchased and distributed a large quantity of shower flow restrictors, dye tablets for toilet leak detection, and plastic containers for toilet volume reduction. Brochures were printed and distributed describing native and naturalized plants and other outdoor water savings methods. A consultant was retained to aid in the program.

Educational teams, supported mostly by Federal funds were trained to teach school groups and the general public to participate in the Water Savings Program.

As a result of the curtailment of imported water, greater demand was placed on underground water supplies resulting in lowered water levels that could cause a recurrence of land surface subsidence. The aim of the District was a voluntary reduction of 25 percent in water use. For the most part, this reduction was accomplished in the North County, while in the South County, due to the lack of sufficient data, it can only be estimated that there was at least a 25 percent reduction in the municipal and industrial usage. Since large row crop acreages were reportedly

left unplanted and some agricultural wells went dry, it is estimated there was also a reduction in agricultural water usage.

WATER RECLAMATION

In its search for new sources of water, the District, as early as 1958, engaged a private consultant* to explore methods of reclamation of sewage and industrial wastewater. An oxidation pond was constructed adjacent to the San Jose Water Pollution Control Plant. Tests were conducted over a two-year period yielding valuable information for future efforts.

Water Reclamation Facility, Palo Alto

It was not until recent years that the first wastewater reclamation facility was planned and built in Santa Clara County. Plant operations began in June 1977 after five years of planning and 18 months of construction. This $6.8 million plant, located on Embarcadero Way east of Bayshore Freeway, can produce high quality water at a rate of four million gallons daily by giving advanced wastewater treatment to effluent discharged from the adjacent Regional Water Quality Control Plant. That plant is operated by the cities of Palo Alto, Mountain View, and Los Altos in conjunction with the East Palo Alto Sanitary District, Stanford University, and the Town of Los Altos Hills. The Reclamation Plant is operated under the direction of the District.

A series of wells close to San Francisco Bay will be used to pump the water into and out of the shallow unused groundwater basin. There are a series of wells in a two-mile line - one set for injection and another for extraction. Auxiliary pipelines transport the reclaimed water and the extracted water.

*The late George L. Sullivan, Dean Emeritus, College of Engineering, University of Santa Clara.

Injected freshwater pushes away saltwater and prevents contamination of inland groundwater basins holding supplies of good quality water. Some of the injected water moves toward the bay and keeps the saltwater from flowing inland.

Some of the injected water moves inland, where extraction wells between the injection wells and the Bayshore Freeway pump out a mixture of intruded saltwater and injected freshwater. This mixed water is pumped into the bay. When there is eventually no more saltwater in the groundwater basin, the reclaimed freshwater will be pumped out and reused.

Water is provided at nominal cost for irrigating Palo Alto's Municipal Golf Course and Rinconada Park in Palo Alto. This water may also be used for industrial purposes in Mountain View and at the National Aeronautics and Space Administration's Ames Research Center and Moffett Field Naval Air Station.

Water Reclamation Facility, Gilroy

The first stage of this wastewater reclamation facility was constructed as an emergency program. This was in response to the need for new water supplies in the Gilroy area resulting from the 1976-77 drought and consequent severe overdraft of the limited underground reservoir.

The facility was constructed jointly by the Santa Clara Valley Water District, City of Gilroy, and South Santa Clara Valley Water Conservation District. Total project cost was $1.9 million. Most of the financing was provided by a loan from the U. S. Bureau of Reclamation under the Emergency Drought Act of 1977.

The facilities constructed to provide the treatment and distribution of the reclaimed water consist of a new oxidation pond, pumping and chlorination stations, and 42,240 feet of distribution pipeline.

Water to be treated comes from the existing primary sewage treatment facilities of the City of Gilroy. The water is pumped into the new oxidation pond which has a surface area of 15 acres and is aerated by eight floating aerators. The detention time in the oxidation pond is 12 to 18 days.

From the oxidation pond the treated water passes through mechanical strainers and is chlorinated. This water is pumped through an eight-mile pipeline to a pre-existing, 120 acre-foot capacity terminal reservoir. The first two miles of the 12-inch steel distribution main acts as the chlorine contact chamber. At that point, the chlorine residual is measured to assure sterilization. If adequate chlorine residual is not maintained, the system is shut down by an automatic control.

The intended use of the recycled water is for irrigation of agriculture and landscaping. The agricultural units are primarily nursery crops, flowers, and seed crops. This market contains about 300 acres. The landscaping irrigation would be at a city park, the city golf course, and a new high school. These markets contain about 150 acres. To date, these users have contracted for 700 acre-feet per year.

The users are furnished water under special contracts which provide for the delivery of and payment for a minimum quantity of water. Additional quantities of water can be supplied if

available. The contracts are for a term of 20 years. The price of water is $10 per acre-foot for water used for agricultural purposes and $40 an acre-foot for water used for municipal purposes.

Water Reclamation Study, North San Jose-Milpitas

This facility is in the planning stages at the present time. Its size and cost will depend on the market and quality requirements developed during the study. This project is in cooperation with the Cities of San Jose, Santa Clara, and Milpitas.

SURFACE WATER QUALITY

Streams

Surface waters of the Santa Clara Valley are generally of excellent mineral quality, characterized by relatively low concentrations of dissolved solids, low percent sodium, and, with some exceptions in the Penitencia area, low boron content.

Under Section 208 of the Federal Water Pollution Control Act a $4.3 million grant has been given to the Association of Bay Area Governments (ABAG) from the U. S. Environmental Protection Agency to identify and develop plans for mitigation of surface runoff quality problems in the San Francisco Bay Area. All local governments and related agencies are participating in the Santa Clara County portion of the "208" Program. The Santa Clara Valley Water District has been a lead agency of the local group. The District has directed the efforts of the consultant, Metcalf and Eddy, in the gathering of data and preparation of background material for the Surface Runoff Management Plan of Santa Clara County. The three basic objectives of the Santa Clara County Runoff Plan are:

1. To determine the nature and magnitude of surface runoff problems in Santa Clara County.

2. To develop a set of recommended actions acceptable to local agencies and to the Association of Bay Area Governments which will adequately mitigate identified surface runoff problems, taking into consideration the magnitude of the problems identified, the costs of implementing effective mitigating measures, and other societal problems and needs competing for limited public funds.

3. To initiate a process for designation of an appropriate local agency as the surface runoff management coordinating agency for Santa Clara County.

The Santa Clara County Surface Runoff Plan is being prepared and will be combined with other Bay Area counties' plans into the Draft Environmental Management Plan for the Bay Area.

A three-way cooperative project to develop a surface water quality monitoring program between the State Department of Water Resources, the U. S. Geological Survey and the District was continued throughout this reporting period. It is expected to be completed in Fiscal Year 1977-78 and implemented in Fiscal Year 1978-79.

Reservoirs

The State Department of Water Resources is cooperating with the District in a limnological investigation of Anderson Reservoir. Limnology is the study of physical, chemical, and biological conditions of a freshwater body and its tributary streams and watershed. Upon completion of the Anderson Reservoir investigation, other reservoirs may be studied. Lexington Reservoir is the next reservoir slated for a limnological investigation.

The product of these investigations will be a collection of adequate baseline water quality data for each reservoir. This information is a valuable tool for identifying sources of contamination and setting reservoir operation criteria. Indications of trends brought out through regular monitoring will make it possible to predict the impact of projected land use changes.

GLOSSARY*

Acre-Foot - A measurement of volume of water equaling 43,560 cubic feet or 325,851 gallons, an amount that would cover an area of an acre, one foot deep (a football field would be covered one and a quarter feet deep).

Aquifer - A geologic formation that stores, transmits, and yields significant quantities of water to wells and springs.

Aquitard - A geologic formation which, although porous and may store large quantities of water, will not transmit water fast enough to yield an appreciable supply for a well.

Artesian Well - A well in which water is lifted by hydrostatic pressure above the land surface at the well.

Biochemical Oxygen Demand (BOD) - The quantity of oxygen consumed in biological processes that decompose organic matter in water.

Confined Aquifer - An aquifer overlain by material sufficiently impervious to retain groundwater in the aquifer under pressure.

Connate Water - Water which was entrapped in a geologic formation at the time the formation was deposited. If the formation was deposited in the ocean or a saline lake, the connate water is also saline.

Consumptive Use - Water consumed by vegetative growth in transpiration and building of plant tissue, and water evaporated from adjacent soil, from water surfaces, and from foliage. Also, water similarly consumed and evaporated by urban and nonvegetative types of land use.

Contamination - An impairment of the quality of water by microorganisms, chemicals, sewage, or industrial waste which renders the water unfit for its intended use. In California, this means the water constitutes an actual hazard to public health (see also Pollution).

Cubic Feet Per Second (CFS) - A unit of measurement of flowing water; the number of cubic feet of water which passes a given point in a second.

Dissolved Oxygen (D.O.) - The oxygen dissolved in water. It is necessary for aquatic life.

Dry Period - An historic period of years when water supply is much below normal. An example was 1929-34 when the water in northern California streams averaged only about 38 percent of normal. It has been used as the reference drought situation in much water resource planning.

*From Santa Clara Valley Water District's "Glossary of Terms", April, 1977.

Evaporation - The process by which surface or subsurface water is converted to atmospheric vapor.

Evapotranspiration - Water withdrawn from soil by evaporation and plant transpiration (a consumptive use).

Flood Insurance - The transfer of the risk of monetary loss due to flooding to another in accordance with the National Flood Insurance Program.

Floodplain - The relatively flat area adjoining a river or lake that may be covered by floodwater.

Gradient - The rate of change per unit of length, such as the slope of the land, stream channel, or any surface.

Groundwater - Subsurface water in saturated porous rocks and soils.

Groundwater Basin - Areas where water is stored below the ground surface.

Groundwater Recharge - The process whereby water seeps from the surface down through soil materials to become groundwater.

Groundwater Recharge Basins - Depressions where water is placed so that it can seep into the ground.

Hydrologic Cycle - The circuit of water movement from the atmosphere to the earth and return to the atmosphere through various stages of precipitation, consequent runoff, streamflow, infiltration and underground movement, eventual evaporation, and reprecipitation.

Hydrology - The applied science concerned with the waters of the earth in all its states - their occurrences, distribution, and circulation through the unending hydrologic cycle.

Hydrology, Groundwater - The branch of hydrology that deals with groundwater, its occurrence, movement, replenishment, and depletion.

Imported Water - Water that is moved from one drainage basin to another. (Example: Water is moved from the Sacramento-San Joaquin Valleys through canals and pipelines into the Santa Clara Valley.)

Infiltration - The movement of water through the soil surface and into the soil.

Injection Well - Well used for introduction water into an aquifer. Technique used to stop seawater intrusion, replenish an aquifer, or dispose of cooling water.

Overdraft - The condition in a groundwater basin where the amount of water withdrawn by pumping exceeds the amount of water replenishing the basin over a long time period.

Perched Groundwater. Groundwater occurring in a saturated zone separated from the main body of groundwater by unsaturated rock (or soil).

Percolation - The movement of water, under natural pressures developed underground, through the interstices of the rock or soil.

Percolation Pond - See Groundwater Recharge Basin.

Permeability - A measure of the ability of a material to convey water.

Piezometric Level - The level to which water will rise in a well that penetrates a confined aquifer.

Point Source - Any discernible confined and discrete conveyance from which pollutants are or may be discharged.

Pollution - The addition of sewage, industrial wastes, or other harmful or objectionable material to water (see also Contamination).

Potable Water - Water which does not contain objectionable pollution, contamination, minerals, or infection and is considered satisfactory for domestic consumption.

Precipitation - The total measurable supply of water received from clouds as rain, snow, hail, or sleet.

Primary Treatment - The first major stage in wastewater treatment, usually sedimentation. Floating and settleable solids are removed in this stage.

Salinity - The concentration of salts dissolved in water.

Secondary Treatment - The second major step in wastewater treatment using biological methods to decompose the organic wastes carried by the water.

Semiperched Groundwater - Shallow groundwater overlying a body of groundwater from which it is not separated by any unsaturated alluvium (perched groundwater but not separated by an unsaturated zone from the main groundwater body; separation is achieved by the nearly impermeable nature of the perching clay layer and if the main groundwater body were drawn down, a true perching condition would result).

Spreading Dam - A low artificial barrier built in a stream to pond water to increase groundwater recharge capacity.

Subsurface Inflow - Underground waters of the hills and mountains or adjacent groundwater basins that move into the groundwater basin under consideration. This water is subsurface outflow from the hills and mountains or the adjacent groundwater basin.

Surface Diversion - The taking of water from a stream or other body of surface water into a canal, pipeline, or other conduit.

Surface Water - Water that rests on the surface of the earth, such as streams and rivers, ponds, lakes, and reservoirs.

Suspended Solids (SS) - Small particles of matter that are carried in suspension in water.

Tertiary - Treatment processes in addition to the normal secondary treatment of wastewaters. Generally, these are chemical and physical processes.

Total Dissolved Solids (TDS) - The amount of organic and inorganic matter (by weight) dissolved in a given quantity of water. It is usually stated in parts per million (ppm) or milligrams per liter (mg/l).

Treated Water - Water that has been treated to make it suitable for domestic service (see Potable Water).

Turbidity - A measure of fine suspended matter (usually colloidal) in liquids. The fine particles may be visible as a bulk unit but are not large enough to be seen as individual particles by the naked eye; in total they restrict the passage of light through the liquid.

Unconfined Aquifer - An aquifer such that the piezometric surface of the groundwater retained within it falls below the bottom of any upper confining bed.

Water Quality - The chemical, physical, and biological properties of water which affect its suitability for use.

Watershed - The land area from which water drains to a given point (a drainage area, drainage basin, or catchment area).

Water Table - The surface where groundwater is encountered in a well in an unconfined aquifer.

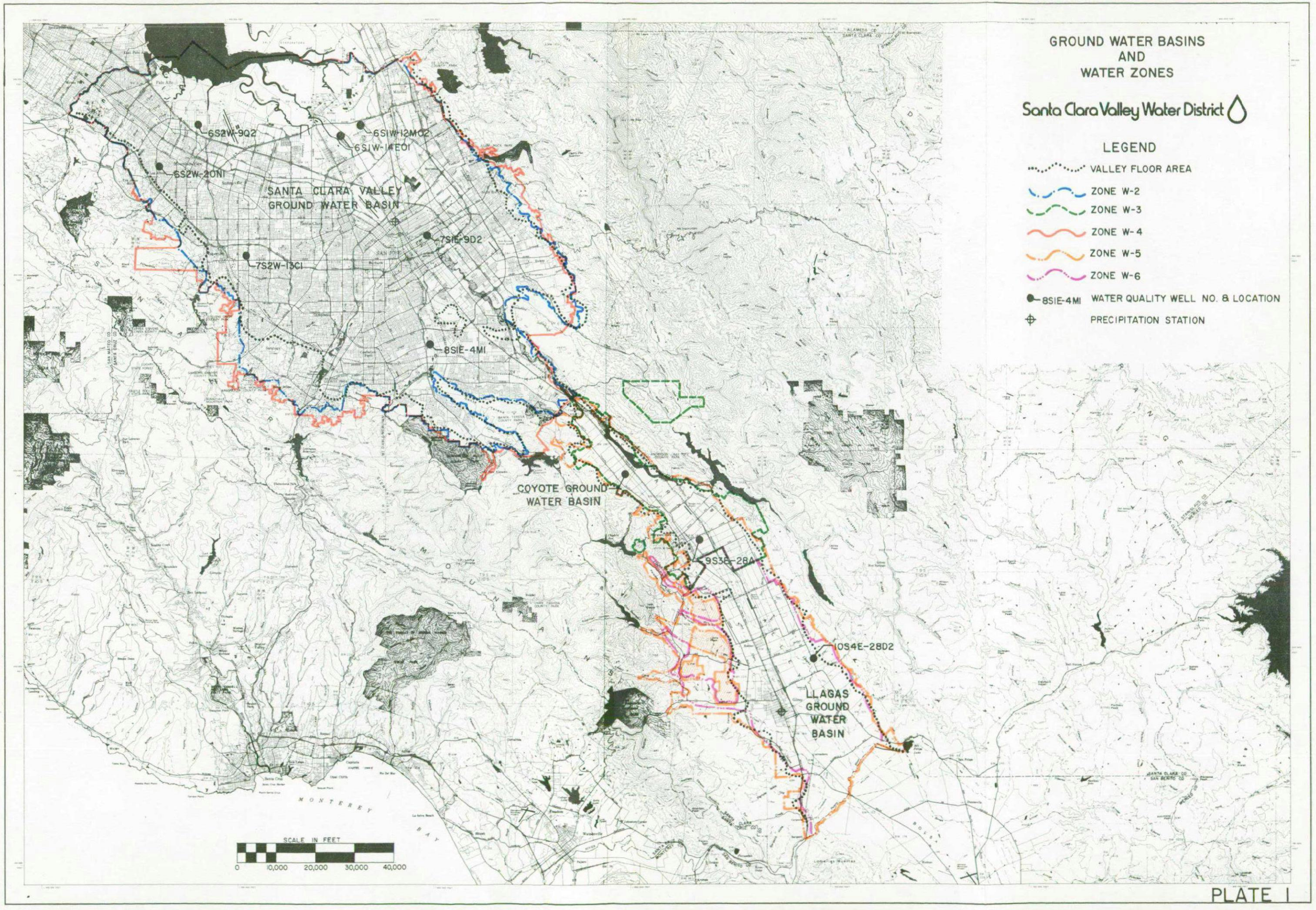

GROUND WATER BASINS
AND
WATER ZONES
Santa Clara Valley Water District
LEGEND
VALLEY FLOOR AREA
ZONE W-2
ZONE W-3
ZONE W-4
ZONE W-5
ZONE W-6
8S1E-4M1 WATER QUALITY WELL NO. & LOCATION
PRECIPITATION STATION
6S2W-9Q2
6S1W-12M02
6S1W-14E01
6S2W-20N1
SANTA CLARA VALLEY
GROUND WATER BASIN
7S1E-9D2
7S2W-13C1
8S1E-4M1
COYOTE GROUND
WATER BASIN
9S3E-28A
10S4E-28D2
LLAGAS
GROUND
WATER
BASIN
MONTEREY
BAY
SCALE IN FEET
0
10,000
20,000
30,000
40,000

PLATE I

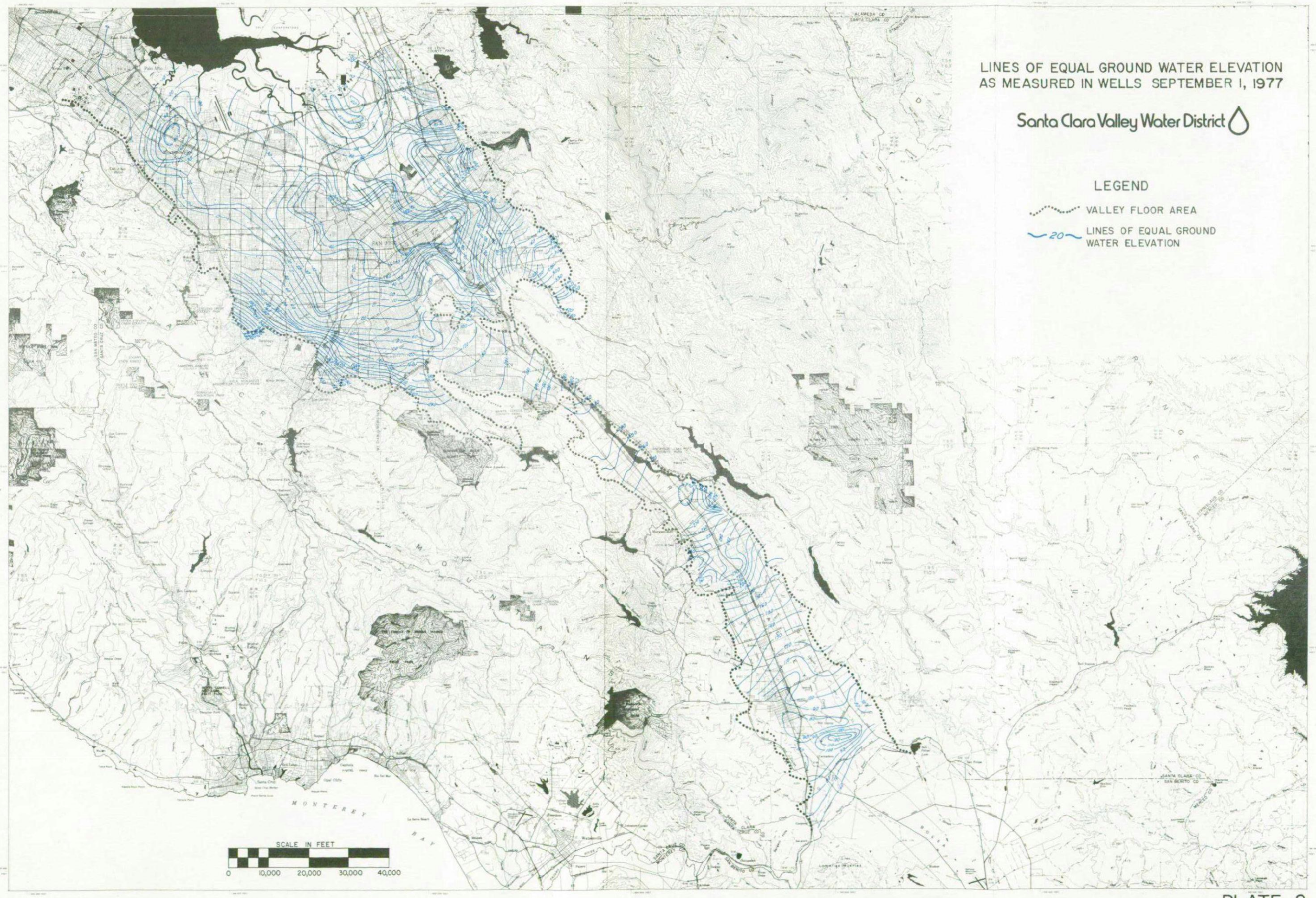

LINES OF EQUAL GROUND WATER ELEVATION
AS MEASURED IN WELLS SEPTEMBER 1, 1977
Santa Clara Valley Water District
LEGEND
VALLEY FLOOR AREA
20
LINES OF EQUAL GROUND WATER ELEVATION
SCALE IN FEET
0
10,000
20,000
30,000
40,000
MONTEREY BAY
SANTA CRUZ MOUNTAINS
ALAMEDA CO
SANTA CLARA CO
SAN MATEO CO
SANTA CRUZ CO
SANTA CLARA CO
SAN BENITO CO
SANTA CLARA CO
MONTEREY CO
SAN BENITO CO

PLATE 2

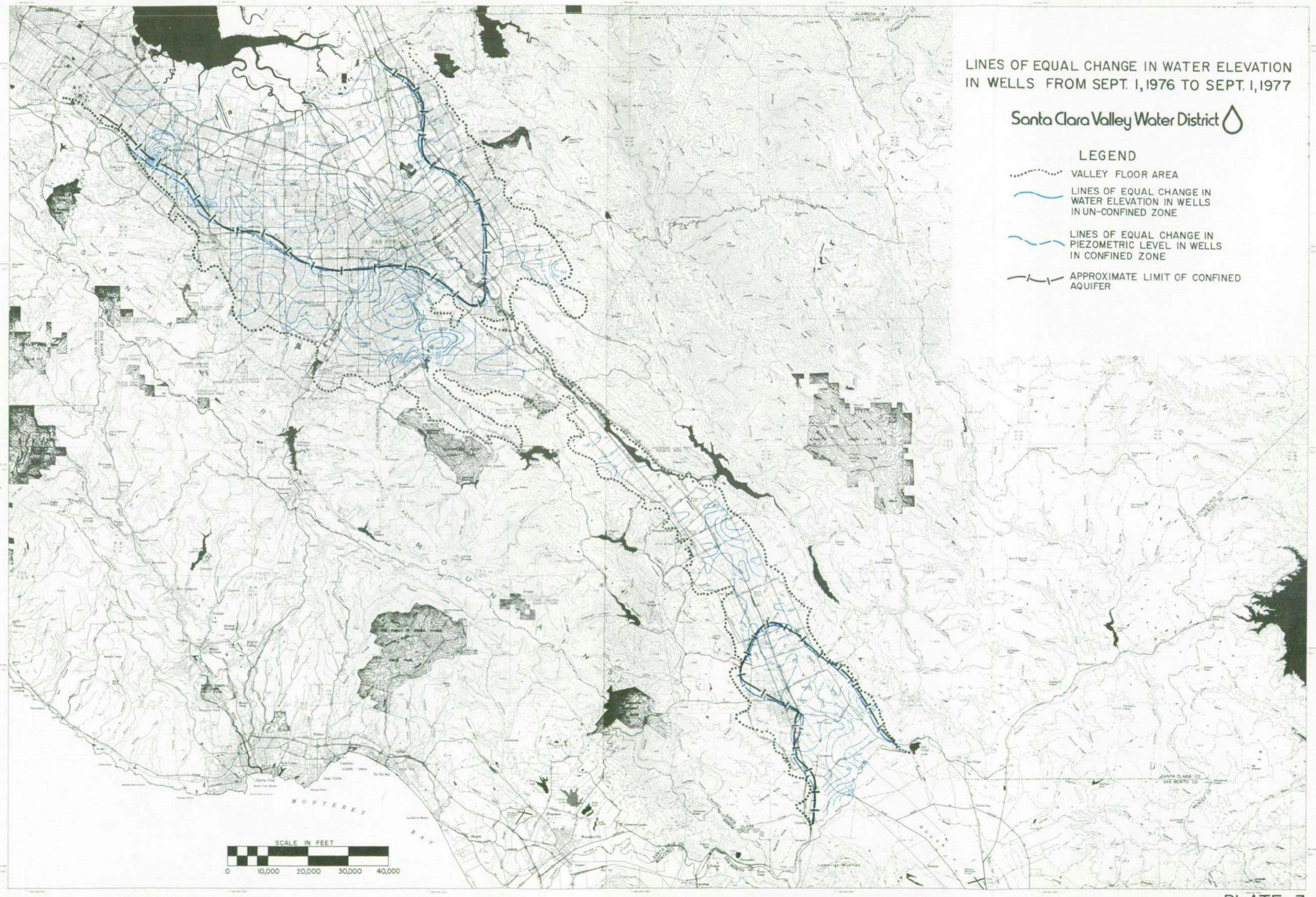

LINES OF EQUAL CHANGE IN WATER ELEVATION
IN WELLS FROM SEPT. 1, 1976 TO SEPT. 1, 1977
Santa Clara Valley Water District
LEGEND
VALLEY FLOOR AREA
LINES OF EQUAL CHANGE IN WATER ELEVATION IN WELLS IN UN-CONFINED ZONE
LINES OF EQUAL CHANGE IN PIEZOMETRIC LEVEL IN WELLS IN CONFINED ZONE
APPROXIMATE LIMIT OF CONFINED AQUIFER
SCALE IN FEET
0
10,000
20,000
30,000
40,000
MONTEREY BAY
SANTA CRUZ MOUNTAINS
SAN JOSE
Santa Cruz
Watsonville
ALAMEDA CO
SANTA CLARA CO
SAN MATEO CO
SANTA CRUZ CO
SAN BENITO CO

PLATE 3

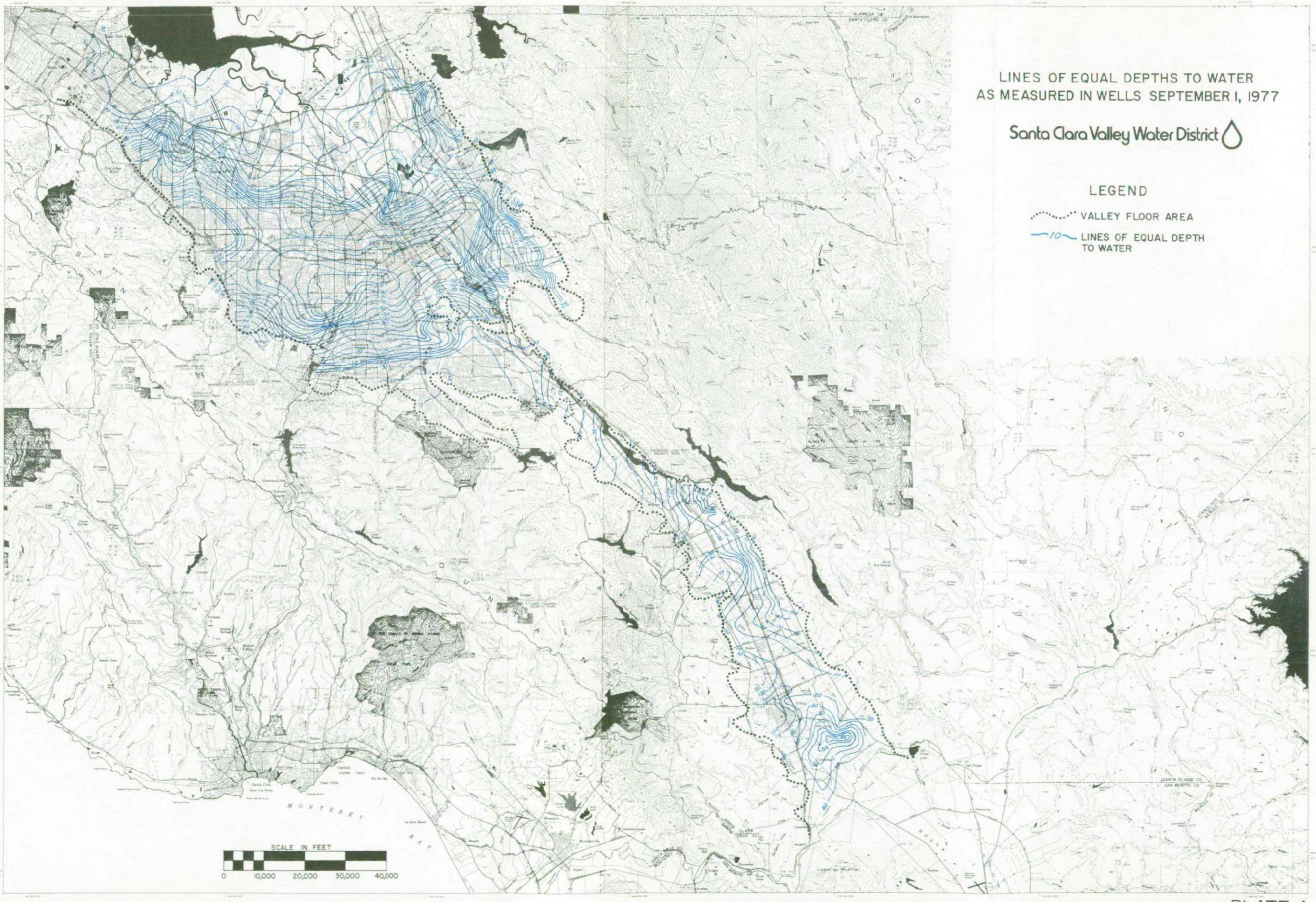

LINES OF EQUAL DEPTHS TO WATER
AS MEASURED IN WELLS SEPTEMBER 1, 1977
Santa Clara Valley Water District
LEGEND
VALLEY FLOOR AREA
10
LINES OF EQUAL DEPTH TO WATER
SCALE IN FEET
0
10,000
20,000
30,000
40,000
MONTEREY
BAY

PLATE 4

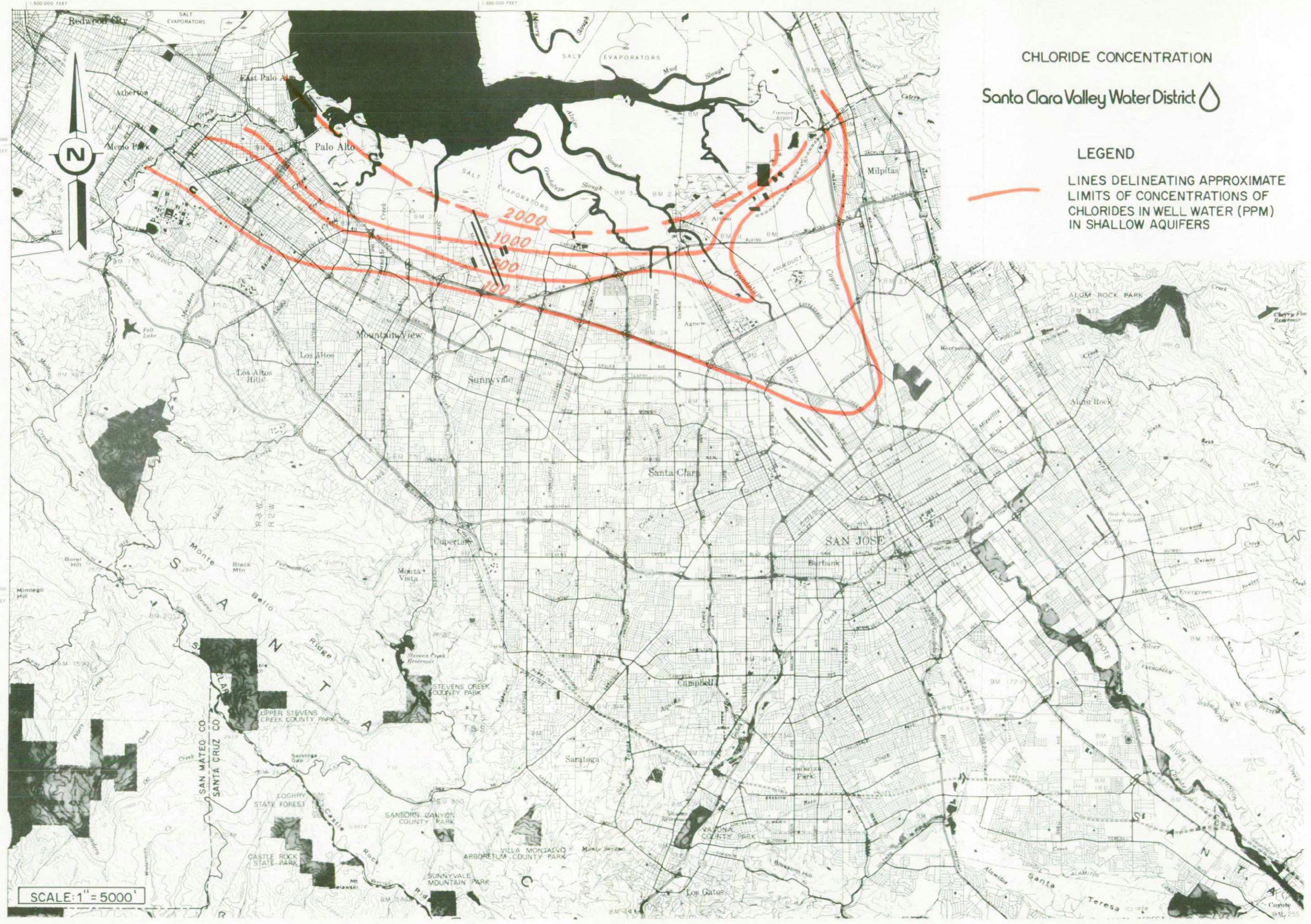

CHLORIDE CONCENTRATION
Santa Clara Valley Water District
LEGEND
LINES DELINEATING APPROXIMATE LIMITS OF CONCENTRATIONS OF CHLORIDES IN WELL WATER (PPM) IN SHALLOW AQUIFERS
2000
1000
500
100
N
Redwood City
Atherton
Menlo Park
Palo Alto
East Palo Alto
Milpitas
Mountain View
Los Altos
Los Altos Hills
Sunnyvale
Santa Clara
SAN JOSE
Cupertino
Burbank
Campbell
Saratoga
Los Gatos
Alum Rock
SALT EVAPORATORS
Mud Slough
Alviso Slough
Guadalupe Slough
Coyote River
Fremont Airport
ALUM ROCK PARK
STEVENS CREEK COUNTY PARK
UPPER STEVENS CREEK COUNTY PARK
SAMBORN CANYON COUNTY PARK
VASONA COUNTY PARK
VILLA MONTALVO ARBORETUM COUNTY PARK
SUNNYVALE MOUNTAIN PARK
CASTLE ROCK STATE PARK
FOGHRY STATE FOREST
SAN MATEO CO
SANTA CRUZ CO
SANTA CLARA CO
SCALE: 1" = 5000'

PLATE 5